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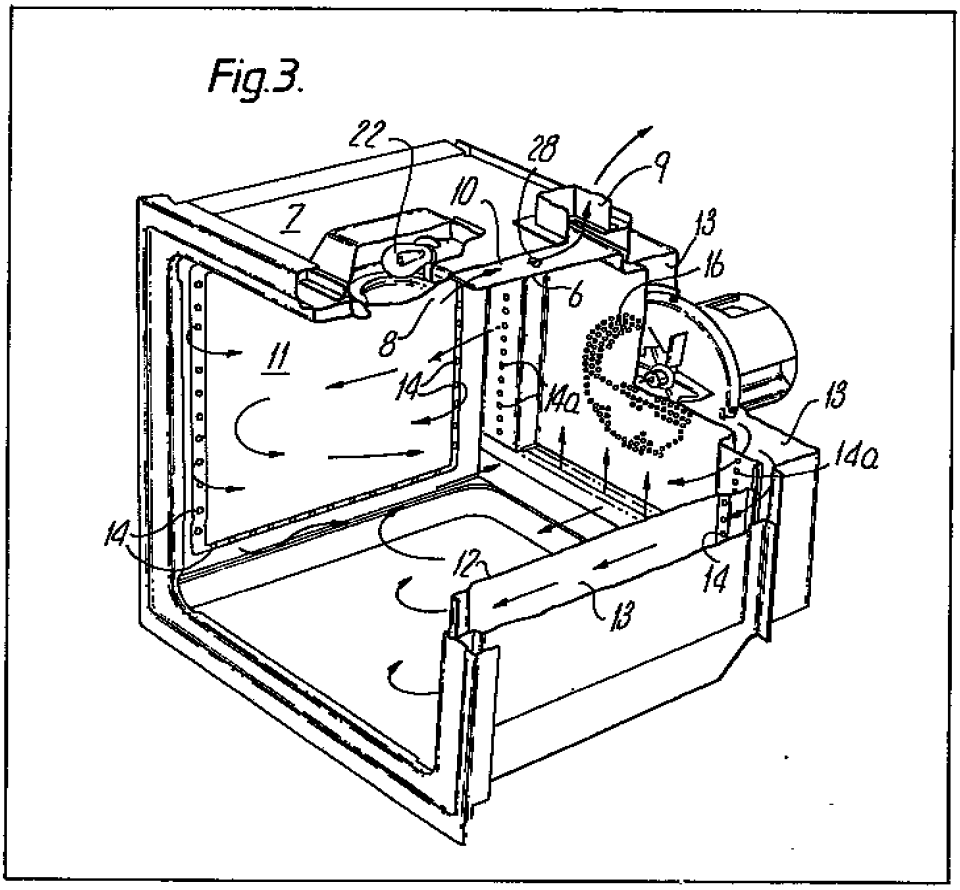
(54) **Dual function cooking oven**

(57) A cooking oven has a cooking chamber surrounded on its back and two sides by a circulating zone (13), and a selectively operable fan disposed so as to draw air through an opening or openings (16) in the rear of the cooking chamber and recirculate it back into the cooking chamber through inlet openings (14) in the sides of the cooking chamber, and the oven incorporating a thermostat probe (28) located in a space (10) between inner and outer roof panels, and temperature regulating means effective to increase the temperature in the roof space when the fan is operating. By this means the temperature in the cooking chamber during a forced convection cooking mode can be reduced to a value substantially equal to that which obtains at the centre of the cooking chamber when the fan is inoperative for the same setting of the oven temperature control. The temperature regulating means may comprises an aperture permitting hotter gases from the circulating zone to pass into the space (10) or an electric heater in the space (10).

Fig.3.



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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

Fig.1.

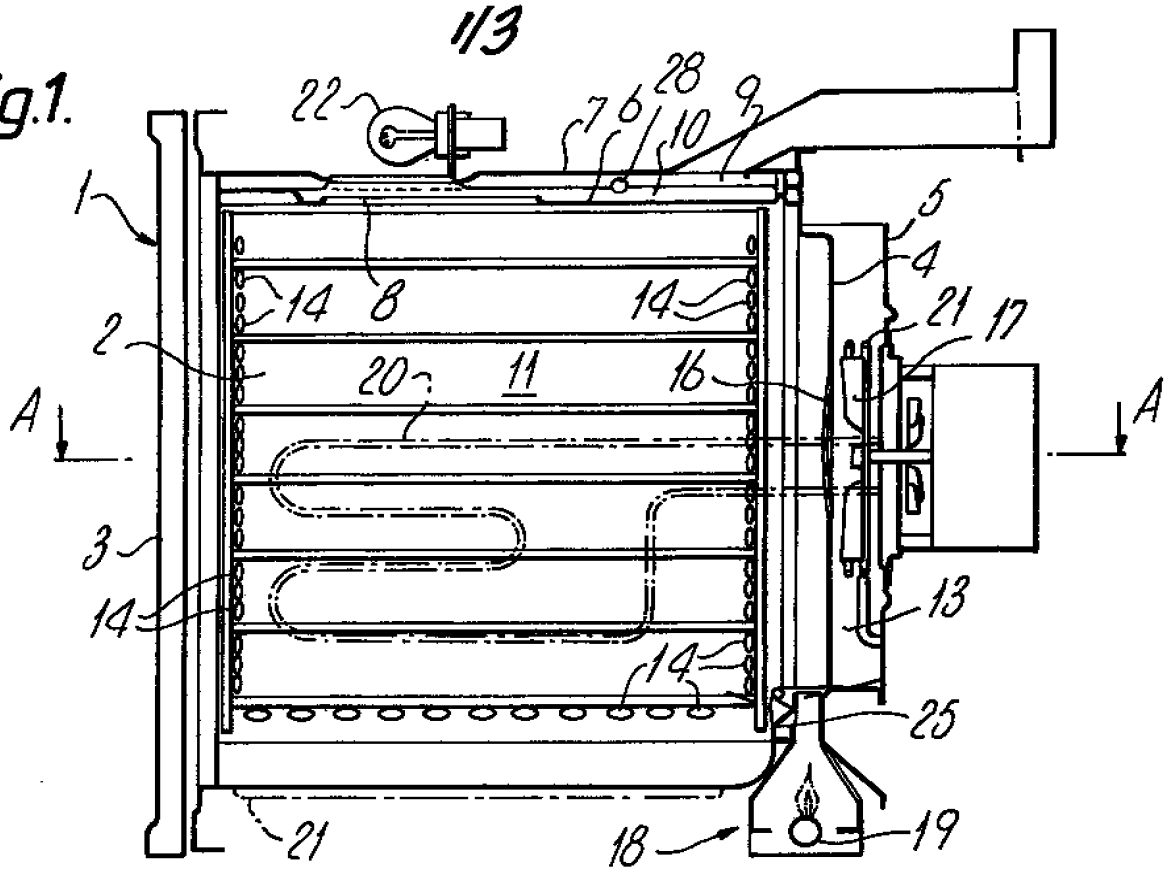
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Fig.2.

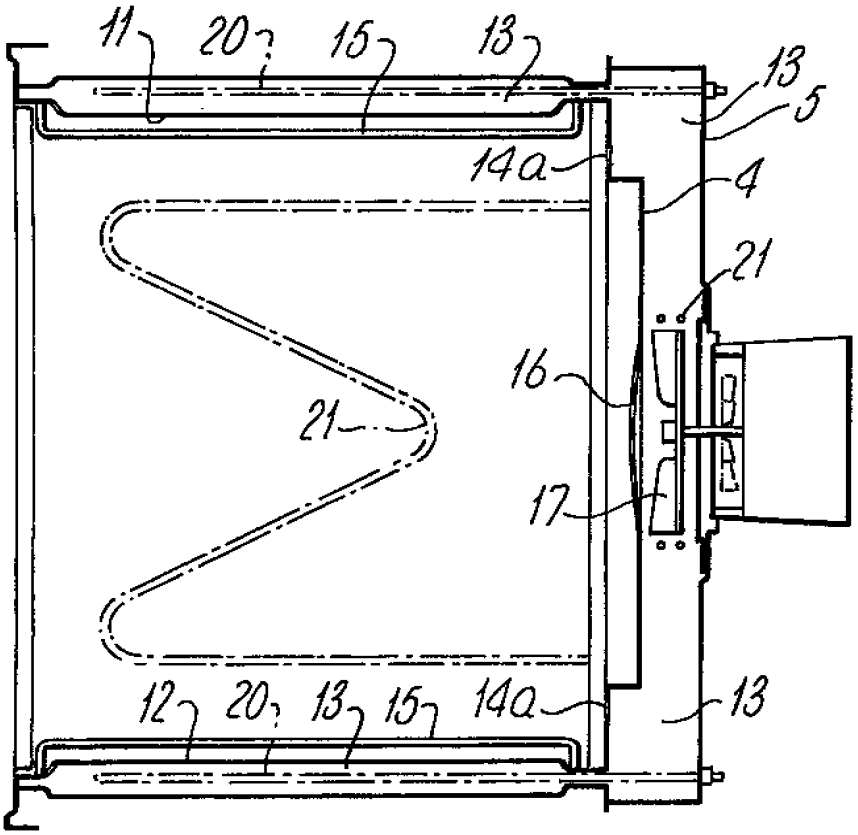
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Fig.3.

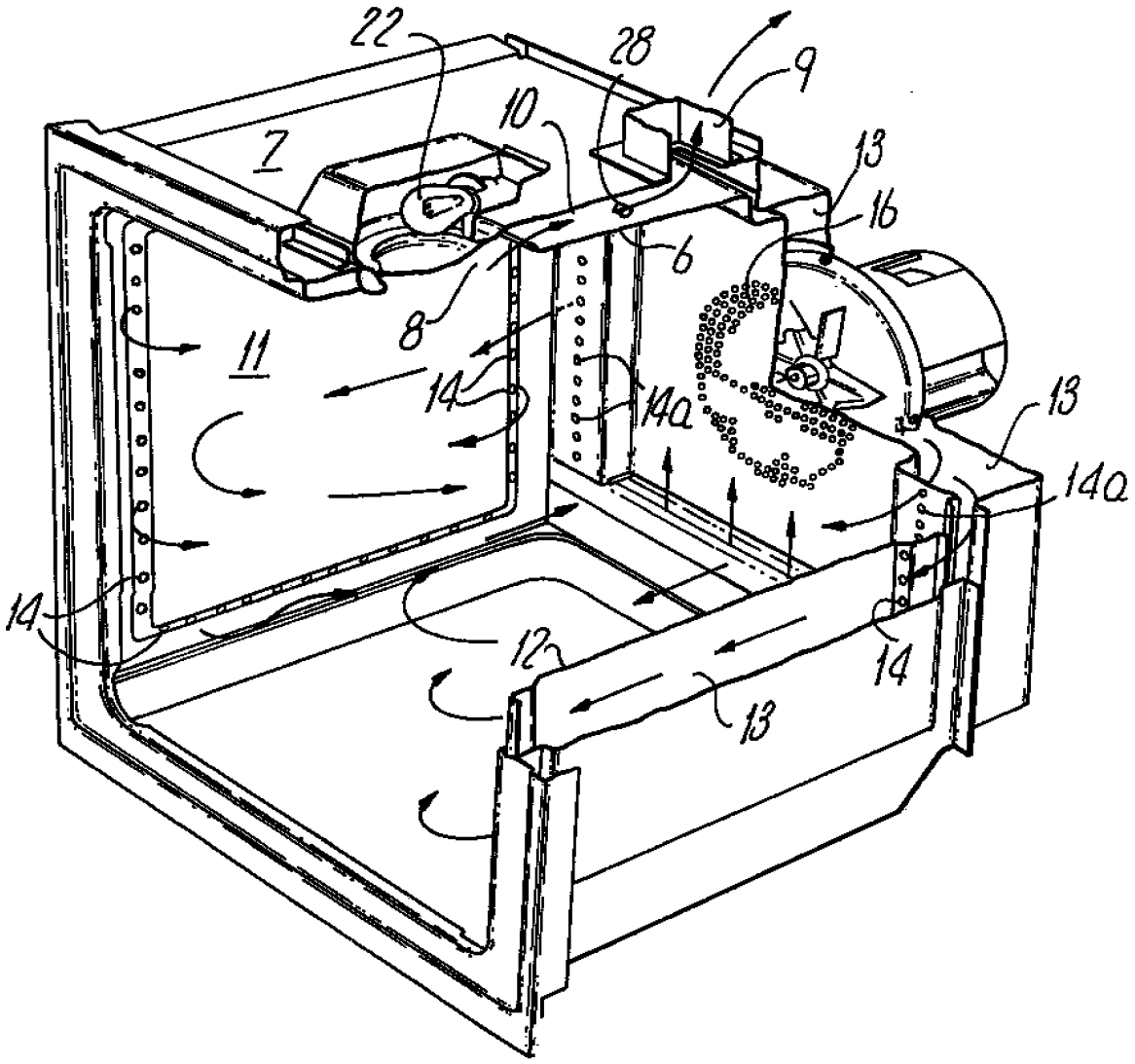

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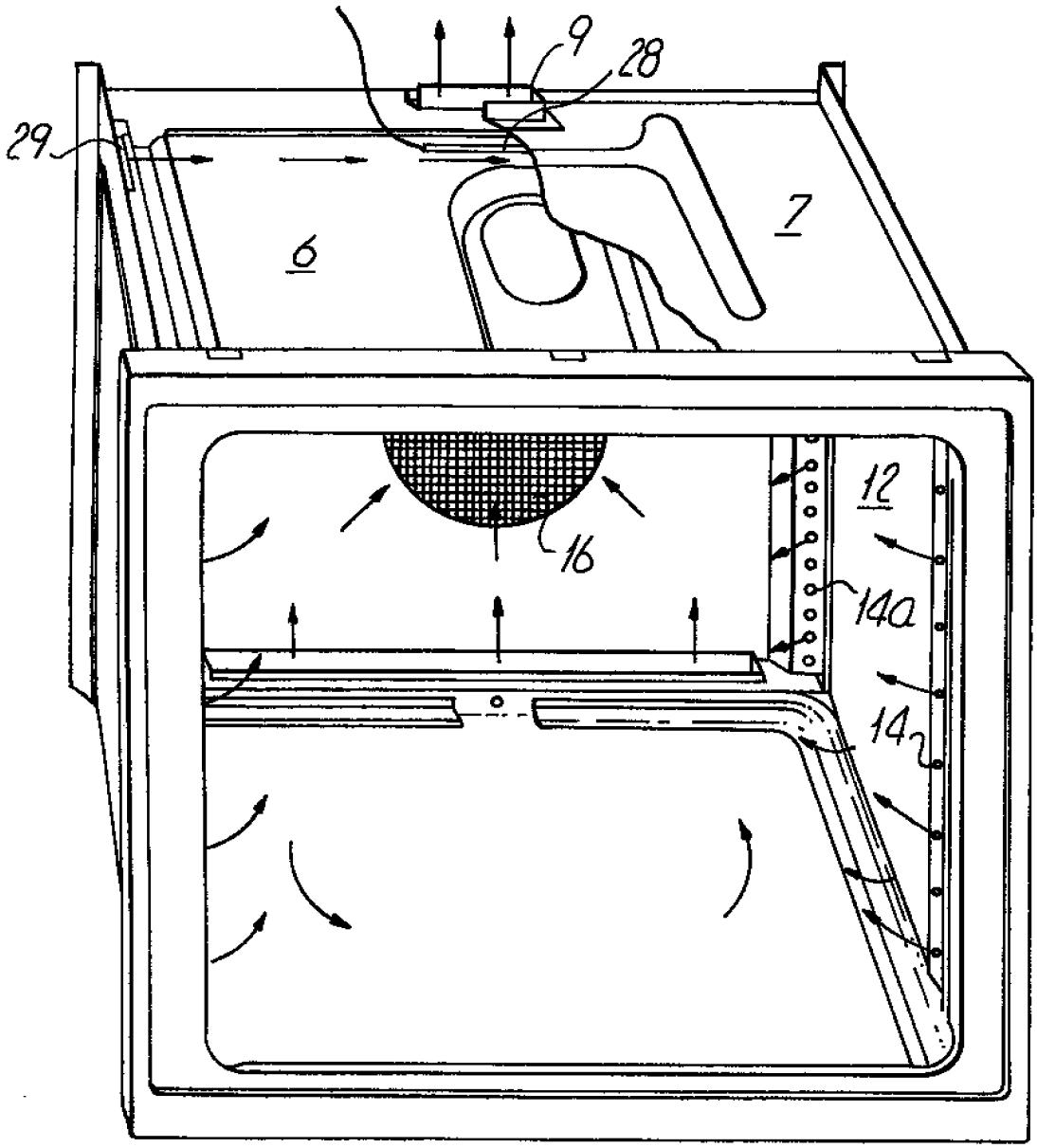
Fig.4.



SPECIFICATION

Dual function cooking oven

This invention relates to dual function cooking ovens, that is to say cooking ovens capable of being used in two different modes of operation, and to temperature regulating means therefor.

More specifically the invention provides for temperature regulating means for an oven for cooking foodstuffs which is capable of providing both a forced convection cooking mode and a zoned cooking mode.

A forced convection cooking mode hereinafter referred to is a cooking cycle wherein a circulation fan is operative to assist in the distribution of heat throughout a cooking chamber in the oven by forced convection circulation of heated air whereby a substantially constant temperature cooking zone is provided throughout the whole of the cooking chamber.

A zoned cooking mode hereinafter referred to is a cooking cycle wherein heating of the cooking chamber takes place by virtue of radiant heat from electric heating elements or by normal convection heating from a gas burner which causes natural convection currents for distribution of heat in the cooking chamber whereby a temperature gradient exists between the top of the cooking chamber and the bottom of the cooking chamber.

The invention is concerned with a means for increasing the temperature at the thermostat probe during a forced convection cooking mode so that the temperature of the cooking chamber is reduced for a predetermined setting of the oven temperature control member.

According to the invention a dual function cooking oven comprises a cooking chamber located within the oven and bounded at the front by the oven door, at the top by an inner roof panel spaced from an outer roof panel and at the rear and opposed sides by panels spaced from the outer walls, a circulating zone extending around the cooking chamber behind the rear and side panels, a circulation fan associated with one or more openings in the rear panel for drawing air from the cooking chamber into the circulating zone through said opening or openings when the fan is operated, said side panels each being apertured to provide inlets for the passage of air into the cooking chamber from the circulating zone, means for heating the cooking chamber and means for selectively energising the heating means and the circulation fan to provide alternatively a forced convection cooking mode or a zoned cooking mode, a thermostat probe associated with a temperature control member for regulating the temperature in the cooking chamber, said thermostat probe being located in the roof space, that is to say the space between the inner roof panel and outer roof panel, to sense the temperature therein, and temperature regulating means effective while the fan is in operation to increase the temperature in the roof space and thereby actuate the temperature probe effectively to reduce the temperature of the cooking chamber.

By suitable design of the temperature regulating means the temperature of the cooking chamber during a forced convection cooking mode may in many cases be reduced to a temperature substantially equal to the temperature at the centre of the cooking chamber during a zoned cooking mode for the same setting of the oven temperature control member.

The temperature regulating means may comprise at least one aperture providing communication between the circulating zone and the roof space.

The heating means may be provided by a gas burner or electric heating elements.

The apertures in a side panel which provide inlets for the passage of air into the cooking chamber are preferably disposed adjacent at least one edge of the side panel.

The roof panel is conveniently formed with an aperture which provides a flueway between the cooking chamber and the roof space and the roof space is provided with a flue outlet, the latter conveniently being provided by an opening at the rear of the outer roof panel. The flueway aperture in the roof panel is preferably located forwardly of the flue outlet with the thermostat probe located between the flueway and the flue outlet.

The aperture which provides communication between the circulating zone and the roof space is conveniently formed adjacent a side edge of the roof panel or an upper edge of a side panel, and is preferably substantially in alignment with the thermostat probe.

In an oven in accordance with the invention the fan may in some cases be energisable independently of the heating means, for use for example for defrosting frozen foodstuffs placed in the cooking chamber.

A preferred embodiment of the invention is illustrated by way of example in the accompanying drawings in which:—

Figure 1 is a sectional side view of an oven according to the invention;

Figure 2 is a sectional plane view along the line A—A of Figure 1;

Figure 3 is a three-quarter cutaway view of the oven of Figure 1;

Figure 4 is a front view partly in section of the oven of Figure 1.

Referring to the drawings an oven for cooking foodstuffs is indicated generally at 1 and comprises a cooking chamber 2 located within the oven and bounded at the front by an oven door 3, which provides access to the cooking chamber, and bounded at the rear by a rear panel 4 spaced from a back outer panel 5 of the oven. The cooking chamber is bounded at the top by an inner roof panel 6 spaced

from an outer roof panel 7, the inner roof panel 6 having an aperture 8, which acts as a flueway and communicates with a flue restrictor and outlet 9 through the roof space 10 between the inner and outer roof panels 6, 7. The cooking chamber 2 is also bounded at each side by inner side panels 11 and 12 spaced from the outer side panels of the oven and at the bottom is bounded by the floor of the oven. The space between the rear panel 4 and back outer panel 5 and the spaces between the inner side panels 11 and 12 and the outer side panels of the oven communicate with each other to form a circulating zone indicated generally at 13 which extends across the rear and round both sides of the cooking chamber 2.

The inner side panels 11 and 12 are each provided with a row or rows of apertures 14 adjacent their side and lower edges which provide communication between the circulating zone 13 and the cooking chamber 2.

The rear panel 4 is provided with a vertically disposed row or rows of apertures 14*a* on each side of the panel adjacent the side panels 11 and 12 which also provide communication between the circulating zone 13 and the cooking chamber 2.

A plurality of horizontally disposed shelf support 15 are arranged in spaced parallel relation on each of the side panels 11 and 12 within the cooking chamber.

The rear panel 4 is provided with a substantially centrally disposed opening or series of openings 16 which may be in the form of a louvre or louvres, and a circulation fan 17 is located rearwardly of the aperture or apertures 16 within the circulating zone 13.

In use, the circulation fan 17 causes heated air and combustion products in the form of hot gases to be extracted from the cooking chamber 2, the heated air and gases being recirculated through the circulating zone 13 back into the cooking chamber 2 through the apertures 14 and 14*a* in the inner side panels 11 and 12 and the rear panel 4.

The fan 17 is electrically operated and is provided with switching means for selectively actuating the fan to provide a forced convection cooking mode while in operation.

A combustion chamber indicated generally at 18 is located below and along the rear lower portion of the cooking chamber 2 and a gas burner 19 can be located along the bottom portion of the combustion chamber to heat the cooking chamber 2 by burning gas.

As an alternative to gas heating, electrical heating elements may be provided for heating the oven. Such electrical heating elements 20 may be located in a vertically disposed plane at each side of the cooking chamber within the circulating zone 13 behind the inner side panels 11 and 12. Additional heating elements 21 may be provided peripherally of the circulating fan and or below the floor of the cooking chamber.

Switch means (not shown) would be provided in such a case for energising the heating elements in the usual way.

Lighting means 22 located in the outer roof panel 7 provides for illuminating the cooking chamber. The lighting means 22 is located behind the aperture 8 and switch means are provided for actuating the lighting means.

When the oven is used in a forced convection cooking mode the circulation fan 17 is actuated so that air and combustion products are drawn by the fan 17 into the circulating zone 13 from the cooking chamber 2, circulated around the sides of the cooking chamber and expelled from the circulating zone through the apertures 14 and 14*a* in the side panels 11 and 12 and rear panel 4 back into the cooking chamber 2 where it is recirculated by the fan to provide a forced convection cooking mode.

Figure 3 shows the airflow path in the oven and circulation zone during a forced convection cooking mode.

At any time during a forced convection cooking mode, whether the oven is gas fired or electrically heated, the fan may be stopped by actuating switch means so that the cooking sequence may continue under natural convection and radiation conditions in a zoned cooking mode.

In the event of a fan failure during a cooking sequence the oven will operate as a non-fanned oven.

The oven may alternatively be used without actuating the fan to provide a zoned cooking mode whereby the temperature of the cooking chamber is greater at the top of the cooking chamber than at the bottom of the chamber.

In conventional zoned gas cooking ovens there is a temperature gradient of some 40°C to 50°C from the top of the cooking chamber to the bottom of the cooking chamber and a thermostat probe is normally located at the top of the cooking chamber. The thermostat dial is normally referenced to the temperature at the centre of the cooking chamber so that the indicia on the dial is normally offset by the difference in temperature gradient between the centre and top of the cooking chamber.

In a zoned cooking mode when the fan is not in use the temperature control of the cooking chamber is conventional. The thermostat probe is exposed to the convection circulation from the cooking chamber through the aperture 8 in the inner roof panel 6.

Because there is a temperature gradient from the base of the cooking chamber to the top of the cooking chamber, the actual temperature at the thermostat probe will be above that of the centre of the cooking chamber, the difference being typically half the vertical temperature gradient of the cooking chamber, approximately 15°C. The relationship will not be exact because the inner roof panel has a modifying effect on the temperature gradient between the cooking chamber base and the outer roof

panel 7, but for a given oven configuration the relationships remain within a reasonable band of tolerance. Transferring a particular thermostat probe from one oven to another will result in fairly small differences in the temperature at the centre of the cooking chamber at the same thermostat setting. Since at a particular setting one thermostat will have a particular probe temperature at thermal stability in a particular type of oven construction variations in the temperature at the centre of the cooking chamber from oven to oven will be due to minor differences in temperature gradient, circulation etc. In its fanned use there will be comparatively little temperature gradient in the cooking chamber and therefore little difference between the probe temperature and the temperature at the centre of the cooking chamber. However, since the cooking chamber is at positive pressure due to the action of the fan, the velocity of the mixture of combustion products and dilution air exiting from the flue will be higher than in the non-fanned operation. In other words there will be a higher heat loss from the cooking chamber in the fanned condition compared to the non-fanned at the same nominal thermostat setting. In turn this will require a higher rate of gas burning to maintain thermal stability. The probe control temperature will therefore be lower in the fanned condition than in the non-fanned condition for the same thermostat setting, the difference in a particular oven configuration could be approximately 4°C. The temperature relationships between the probe and the centre oven temperature could be:—

	Non-Fanned	Fanned
Probe Control Temperature	X°C	X — 4°C
Centre Cooking Chamber Temp.	(X — 15)°C	X — 4°C

Differential = 11°C

These are the relationships which will occur for a particular conventional oven construction, and would vary between one method of construction and another. The purpose of the invention is to achieve control over the differential temperature at the centre of the cooking chamber.

It would be of convenience to the user of the oven if the thermostat setting were the same for either fanned or non-fanned cooking of the same dish leaving the only difference as being the length of time of cooking. The relationships outlined in the table where the temperature at the centre of the cooking chamber in the fanned condition is approximately 11°C above that in the non-fanned condition means in practice that the thermostat setting has to be reduced by approximately one Gas Mark between the non-fanned and fanned conditions for the same dish.

The invention is concerned with a method of reducing the cooking chamber centre temperature in the fanned condition.

Because the circulating zone is relatively restricted there will be a temperature gradient through its effective length, the cooking chamber is relatively unrestricted and will have a very small temperature gradient in any direction. Under normal conditions the thermostat probe will be at about the same temperature as that generally obtaining within the cooking chamber 2. The temperature at the inlet to the restricted circulating zone and within the zone 13 will be significantly higher than that of the cooking chamber and hence the thermostat probe.

The invention proposes that a small proportion of this mixture of combustion products and dilution air from the circulating zone is introduced directly into the roof space 10 between the inner and outer roof panels 6, 7. This will raise the temperature within this space above that of the cooking chamber by an amount which will depend upon the quantity and temperature of the gases introduced; the restriction provided by the inner roof panel and the direction of flow of the gases from the cooking chamber to the flue will ensure that the temperature within the cooking chamber is substantially less affected. The temperature of the thermostat probe will then be above that of the centre of the cooking chamber.

Since, for a particular thermostat, stable thermal conditions will be achieved at a particular probe temperature, this new temperature relationship where the probe temperature is above that of the temperature at the centre of the cooking chamber means that the temperature under fanned conditions of the centre of the cooking chamber will be lowered dependent on the volume and temperature of the mixture of gases which is introduced from the circulating zone to the space around the thermostat probe.

The pressure within the circulating zone is positive with respect to the oven chamber and the roof space 10.

In the present oven construction a thermostat probe 28 is mounted on a bracket horizontally within the roof space 10 adjacent the flue outlet, and an aperture 29, located at the edge of the inner roof panel 6 between the top of a side panel 11 and the adjacent outer side walls of the oven, substantially in alignment with the thermostat probe, is provided to introduce the hotter gases from the circulating zone 13 to be entrained and mixed with the flow of gases from the aperture 8 in the inner roof panel 6 to the flue outlet, in order to raise the temperature above that of the temperature in the cooking chamber when the fan is in operation.

Figure 4 shows the flue gases and airflow path in the oven by black arrows and the white arrows show the airflow from the circulation zone through the space 10 to the thermostat probe 28 in the flue outlet between the inner and outer roof panels 6 and 7.

The effect depends on the higher temperature of the gases within the circulating zone during fanned operation, together with the positive pressure within this zone relative to the cooking chamber and hence the roof space 10. Under non-fanned conditions these factors are not present.

Thus the introduction of these hotter gases into the roof space 10 will selectively lower the temperature at the centre of the oven chamber in the fanned condition relative to the unfanned condition at the same thermostat setting. The amount by which this temperature is lowered is controlled by the relative volume of the hotter gases from the circulating zone compared to the volume of gases introduced from the cooking chamber through the inner roof aperture 8.

Hence the position and area of the aperture 29 at the edge of the roof panel 6 in the top of the inner rear and side panels which enclose the circulating zone can be used to lower selectively the temperature of the cooking chamber under fanned conditions whilst not affecting temperatures in non-fanned conditions.

Though the text has referred to the use of an aperture 29 in the side edge of the inner roof panel any means of introducing the hotter gases from the circulating zone to the space between the inner and outer panels to effectively lower the temperature of the cooking chamber under fanned conditions may be substituted for the aperture 29.

For example the aperture may alternatively be provided at the rear of the oven, to provide direct communication between the part of the circulating zone behind the rear panel 14 and the roof space 10.

It is important that the inner roof panel is relatively well sealed to the cooking chamber to ensure that the flow of gases to the roof space 10 is relatively well controlled.

The size and position of the aperture 29 or any other means of introducing an admixture of hotter gases from the circulating zone are important, but may readily be ascertained by experiment or trial for any particular oven in order to obtain the required temperature regulation.

The hot gases within the circulating zone should not be stratified.

The position and sizes of the apertures connecting the circulating zone to the cooking chamber should be arranged so as to create a positive pressure within the circulating zone relative to the cooking chamber when the fan is operating.

Whilst the temperature in the space 10 between the inner roof panel 6 and the outer roof panel 7 which accommodates the thermostat probe 28 may be raised by admitting combustion products and dilution air directly into the space when the fan is operating as above described, but alternative or additional means may be employed for this purpose. For example an electric heater located in the space may be arranged to be energised only when the fan is operated, for raising the temperature within the space 10 by a required amount.

CLAIMS

1. A dual function cooking oven comprising a cooking chamber located within the oven and bounded at the front by the oven door, at the top by an inner roof panel spaced from an outer roof panel and at the rear and opposed sides by panels spaced from the outer walls, a circulating zone extending around the cooking chamber behind the rear and side panels, a circulation fan associated with one or more openings in the rear panel for drawing air from the cooking chamber into the circulating zone through said opening or openings when the fan is operated, said side panels each being apertured to provide inlets for the passage of air into the cooking chamber from the circulating zone, means for heating the cooking chamber and means for selectively energising the heating means and the circulation fan to provide alternatively a forced convection cooking mode or a zoned cooking mode, a thermostat probe associated with a temperature control member for regulating the temperature in the cooking chamber, said thermostat probe being located in the roof space, that is to say the space between the inner roof panel and outer roof panel, to sense the temperature therein, and temperature regulating means effective while the fan is in operation to increase the temperature in the roof space and thereby actuate the temperature probe effectively to reduce the temperature of the cooking chamber.

2. An oven according to Claim 1 wherein the heating means comprises a gas burner located in a combustion chamber beneath and at the rear of the cooking chamber.

3. An oven according to Claim 1 wherein the heating means comprises electric heating elements located within the regions of the circulating zone between the side panels and the adjacent outer walls.

4. An oven according to any preceding Claim wherein the apertures in a side panel which provide inlets for the passage of air into the cooking chamber are disposed adjacent at least one edge of the side panel.

5. An oven according to any preceding Claim wherein the roof panel is formed with an aperture which provides a flueway between the cooking chamber and the roof space and the roof space is provided with a flue outlet.

6. An oven according to Claim 5 wherein the flue outlet is provided by an opening at the rear of the outer roof panel.

7. An oven according to Claim 5 or 6 wherein the flueway aperture in the inner roof panel is

located forwardly of the flue outlet.

8. An oven according to Claim 7 wherein the thermostat probe is located between the flueway and the flue outlet.

9. An oven according to any preceding Claim wherein the temperature regulating means comprises at least one aperture providing communication between the circulating zone and the roof space.

10. An oven according to Claim 9 wherein a said aperture which provides communication between the circulating zone and the roof space is formed adjacent a side edge of the roof panel or an upper edge of a side panel.

11. An oven according to Claim 10 wherein said aperture which provides communication between the circulating zone and the roof space is substantially in alignment with the thermostat probe.

12. An oven according to any preceding Claim wherein the position and sizes of the apertures connecting the circulating zone to the cooking chamber are arranged so as to create a positive pressure within the circulating zone relative to the cooking chamber when the fan is operating.

13. An oven substantially as shown in and as hereinbefore described with reference to Figures 1 to 4 of the accompanying drawings.

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